

INTAKE AIR COOLING DEVICE FOR ENGINE

FIELD OF THE INVENTION

[0001] The present invention relates to an intake air cooling device for an engine, and more particularly to an intake air cooling device for an engine, which contributes to improvement of the assembling performance of the engine.

BACKGROUND ART

[0002] An engine (an internal-combustion engine) has properties such that as the temperature of intake air is lowered, the density of intake air, namely, the weight of intake air increases. Thus, it is possible to combust fuel of a large amount and to improve the engine output. In view of the above, particularly in an engine with a supercharger, an intercooler is disposed on an intake path for cooling intake air.

[0003] In this case, employing a water cooling intercooler, and disposing the intercooler at a position near intake ports by integrally mounting the intercooler at a position immediately upstream of an intake manifold is advantageous in efficiently introducing intake air of a low temperature to cylinders. For instance, Japanese Unexamined Patent Publication No. 2001-248448 (hereinafter, referred to as Patent Literature) discloses an intake air cooling device for an internal combustion engine as described above.

[0004] When an intercooler is integrally mounted at a position immediately upstream of an intake manifold, if the position of the intercooler is lower than the position of intake ports, water (condensed water) may deposit within the intercooler. When the deposited condensed water is introduced to a combustion chamber together with intake air, an accidental fire may occur. In view of the above, it is desirable to set an intercooler to a relatively high position so that condensed water is speedily introduced to a combustion chamber without depositing within the intercooler. However, there is a limit on an increase in the height of an intercooler, taking into consideration the height of a hood.

[0005] Therefore, it is appropriate to dispose an intercooler at a position immediately outside an intake manifold on the side opposite to a cylinder head, as far as the intercooler is not lower than intake ports. However, an intake manifold is fastened to a surface of a cylinder head by bolts and nuts. Therefore, when an intercooler is integrally mounted at a position immediately outside an intake manifold, the intercooler may be an obstacle, i.e. the fastening position of the intake manifold is hidden by the intercooler. This may make it difficult to perform the operation of fastening an intake manifold, and may impair the assembling performance of an engine.

SUMMARY OF THE INVENTION

[0006] An object of the present invention is to provide an intake air cooling device for an engine, which enables to integrally mount an intercooler at a position immediately outside an intake manifold on the side opposite to a cylinder head without impairing the assembling performance of the engine.

[0007] An aspect of the present invention is directed to an intake air cooling device for an engine with a supercharger, the engine including a cylinder head with a surface in which intake ports are opened, and an intake manifold fixed to the

surface of the cylinder head and configured to communicate with the intake ports. The intake air cooling device includes an intercooler which is disposed laterally of the cylinder head and is configured to cool intake air. The intake manifold includes a manifold body fastened to the cylinder head and substantially horizontally extending in a direction orthogonal to a cylinder array direction; and a cooler forming portion integrally communicating with an upstream end of the manifold body in an intake air flow direction, and constituting a lower end of the intercooler. When it is assumed that the cooler forming portion is a second cooler forming portion, the intercooler includes a first cooler forming portion to be mounted on an upper portion of the second cooler forming portion, the intercooler being constituted by the first cooler forming portion and the second cooler forming portion. The manifold body includes a plurality of fixing portions to be fastened to the surface of the cylinder head, the plurality of fixing portions being located on the outside of the second cooler forming portion when the engine is viewed from a side in a direction orthogonal to the cylinder array direction.

[0008] These and other objects, features and advantages of the present invention will become more apparent upon reading the following detailed description along with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is an overall configuration diagram of an engine provided with an intake air cooling device according to a first embodiment of the present invention;

[0010] FIG. 2 is a perspective view of the engine when viewed from the intake side;

[0011] FIG. 3 is a plan view of the engine;

[0012] FIG. 4 is a front view of the engine, specifically, illustrating an intake manifold and an intercooler;

[0013] FIG. 5 is a perspective view of an assembly of the intake manifold and the intercooler;

[0014] FIG. 6 is an exploded perspective view of the intake manifold and the intercooler;

[0015] FIG. 7 is a sectional view of the intake manifold taken along the line VII-VII in FIG. 6;

[0016] FIG. 8 is a perspective view of an engine body illustrating a state that the intake manifold is mounted;

[0017] FIG. 9 is a front view of an engine, specifically, illustrating an intake manifold and an intercooler of an intake air cooling device according to a second embodiment of the present invention;

[0018] FIG. 10 is a front view of an engine body illustrating a state that the intake manifold is mounted;

[0019] FIG. 11 is a perspective view of an engine provided with an intake air cooling device according to a third embodiment of the present invention, when viewed from the intake side;

[0020] FIG. 12 is a front view of an intake manifold and an intercooler of the engine;

[0021] FIG. 13 is a side view of the intake manifold and the intercooler;

[0022] FIG. 14 is an exploded perspective view of the intake manifold and the intercooler;

[0023] FIG. 15 is a sectional view of the intake manifold and the intercooler taken along the line XV-XV in FIG. 13;

[0024] FIG. 16 is a diagram illustrating a step of mounting the intake manifold on a cylinder block;